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Effectiveness of E-Modules Assisted by Heyzine Flipbooks Topics of Temperature and Heat Integrated in Ethnoscience to Improve Students' Literacy Science Abilities

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Abstract: This study explores the effectiveness of an e-module supported by Heyzine Flipbooks, specifically targeting the topics of temperature and heat integrated with ethnoscience, to enhance students' science literacy abilities. Conducted with 24 seventh-grade students in East Lombok, the research employed a Research and Development (R&D) approach, adhering to the 4D model (Define, Design, Develop, Disseminate). The results demonstrated a significant improvement in students' literacy, with average pre-test scores increasing from 29 to 77 post-test, resulting in an N-gain of 68%. The findings suggest that the e-module effectively enhances students' capabilities in explaining scientific phenomena, evaluating investigations, and interpreting data, particularly through the integration of local cultural contexts. The study concludes that digital learning media, when combined with ethnoscience, can foster meaningful science learning experiences.

Keywords: E-Modules; Ethnoscience; Literacy Science

Introduction

In the era of technological advancement and the demands of the 21st century, the education sector is required to adapt by integrating innovative learning media to enhance students' understanding and competencies (Zahro, 2024; OECD, 2022; Ghafara et al., 2022; Hapsari & Zulherman, 2021). The use of technology in learning not only enables a more interactive and engaging presentation of materials but also encourages active student participation in the learning process (Aulia et al., 2025; Putra & Anam, 2024).

The rapid development of information and communication technology has influenced various aspects of life, including education, which is one of the sectors most affected by these advancements (Sawu et al., 2023; Pare & Sihotang, 2023; Doyan et al., 2023). In line with this, 21st-century learning requires the integration of technology into the teaching and learning process to meet the competencies needed in the modern era (Dewi et al., 2022; Zakaria, 2021; Akhwani, 2020; Syuzita & Sukarso, 2023).

Moreover, the rapid advancement of science and technology demands the availability of high-quality human resources to face global challenges in the future (Doyan et al., 2020). One of the primary goals of science education is to develop students' scientific literacy, enabling them to understand scientific concepts and apply them in daily life (Siregar et al., 2025; Muliastrini, 2025; Kemdikbud, 2021). Scientific literacy includes the ability to identify scientific questions, explain scientific phenomena, and evaluate information related to science (Tillah et al., 2025; Limiansih et al., 2024; Bybee, 2020). Additionally, scientific literacy involves understanding the characteristics of science, recognizing the impact of science and technology on the physical, intellectual, and cultural environment, and applying scientific knowledge to identify problems, explain phenomena, draw evidence-based conclusions, and make decisions on scientific and environmental issues (Nudiati & Sudiapermana, 2020; Budiarti, 2021; Limiansih et al., 2024). Thus, scientific literacy is not only focused on theoretical understanding but also on the practical application of scientific knowledge in real-world contexts. Understanding the nature of science is also a fundamental aspect of building scientific literacy, as it helps students comprehend how scientific knowledge is

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constructed and validated (Setiyawati et al., 2024; Lederman & Lederman, 2019).

However, several studies indicate that students' scientific literacy levels remain relatively low, necessitating improvements in teaching strategies and learning resources (Suryadi & Kaniawati, 2020). The 2022 PISA results show that Indonesian students' reading literacy score was 359, marking a decline from the previous assessment and remaining below the global average score (OECD, 2022). This highlights the urgent need for improving the quality of education in Indonesia (Rahayu & Hidayat, 2021). Furthermore, interactive approaches in science learning, as proposed by Hake (2020), have been proven effective in increasing student engagement and conceptual understanding.

The integration of digital learning media, such as e-modules, has emerged as an effective approach to enhancing the quality of science education (Nugraha & Suyanto, 2022). E-modules offer interactive features that engage students and facilitate self-directed learning (Hasanah & Priyanto, 2020). The use of Heyzine Flipbooks, an innovative e-module platform, provides a digital learning experience resembling traditional books while increasing student interest through multimedia content such as images, animations, and videos (Wulandari & Supriyanto, 2023). This digital approach is highly effective in facilitating the understanding of abstract scientific concepts such as temperature and heat (Saputri & Rukayah, 2023). Additionally, conceptual change in science learning, as described by Duit & Treagust (2019), can be facilitated through the use of interactive and contextual learning media.

Moreover, integrating ethnoscience into teaching materials strengthens students' contextual understanding by linking scientific concepts with local culture and traditional knowledge (Fadilah & Suryani, 2023). Learning materials become more engaging when they incorporate cultural aspects or environmental characteristics relevant to students (Sari et al., 2020). Ethnoscience emphasizes the integration of scientific knowledge with local wisdom, allowing students to recognize the relevance of science in their communities (Pratiwi et al., 2019). For instance, traditional practices such as salt and keris-making in Indonesia involve processes related to temperature and heat, which can serve as valuable learning contexts (Wulandari & Supriyanto, 2023). The importance of increasing students' interest and aspirations in science is also emphasized by Tytler & Osborne (2020), who state that relevant and contextual learning can encourage students to develop a greater interest in and engagement with science.

The combination of an e-module supported by Heyzine Flipbooks with ethnoscience-based content is expected to create a more meaningful learning experience, increase students' interest, and strengthen their scientific literacy skills (Rahayu & Hidayat, 2021). Therefore, this study aims to examine the effectiveness of an e-module supported by Heyzine Flipbooks on the topic of temperature and heat, integrated with ethnoscience, in enhancing students' scientific literacy skills (Suryadi & Kaniawati, 2020). Thus, this study aims to investigate the effectiveness of an e-module assisted by Heyzine Flipbooks on the topic of temperature and heat, integrated with ethnoscience, in improving students' scientific literacy abilities.

Method

Research and Development (R&D) is defined by Sugiyono (2019) as a research method aimed at creating and testing the effectiveness of a product. Sukmadinata (2010) also states that the purpose of R&D is to develop new products or improve existing ones. This study employs the 4D development model, consisting of Define, Design, Develop, and Disseminate stages (Thiagarajan et al., 1974). The research focuses on analyzing the effectiveness of the Heyzine Flipbooks e-module on the topic of temperature and heat, integrated with ethnoscience, to enhance students' Literacy Science Abilities.

The effectiveness of the product is assessed using the N-gain test, which evaluates the improvement in students' learning outcomes after the implementation of the developed product.

$$N - gain\ (g) = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \times 100\% \quad (1)$$

Explanation:
N-gain : gain score
S_{post} : posttest score
S_{pre} : pretest score
S_{max} : ideal maximum score

Based on the Standard Gain values obtained, Literacy Science Abilities are categorized according to Table 1.

Table 1. N-gain Criteria

Interval	Criteria
$g > 70$	High
$30 \leq g \leq 70$	Medium
$g < 30$	Low

Hake (1988)

To assess the percentage of learning effectiveness after using the science e-module assisted by Heyzine Flipbooks integrated with ethnoscience, this study applies the classical completeness criteria. Based on

these criteria, the product is considered ineffective if the N-gain percentage is $p \leq 20\%$, less effective if $20\% < p \leq 40\%$, moderately effective if $40\ \% < p \leq 60\ \%$, effective if $60\% < p \leq 80\%$, and highly effective if $p > 80\ \%$ (Widoyoko, 2017).

Result and Discussion

This research was conducted through four development stages, namely Define, Design, Develop, and Disseminate. The Define stage aimed to analyze the need for developing an ethnoscience-based e-module as an effort to improve students' Literacy Science Abilities, emphasizing the aspects of planning, monitoring, and evaluating the learning process. The Design stage focused on designing an ethnoscience-based e-module using the Heyzine Flipbooks platform with a problem-based learning (PBL) approach. This e-module integrates the traditional processes of keris-making and salt production into the topic of temperature and heat, along with the development of an instrument to measure students' Literacy Science Abilities

The Develop stage was aimed at producing an e-module that was validated by subject matter and media experts, followed by a limited trial to assess its feasibility and effectiveness in improving students' Literacy Science Abilities. The Disseminate stage involved distributing the e-module, which had proven to be feasible and effective, to expand its use in learning and support the enhancement of students' Literacy Science Abilities. The dissemination phase was carried out through a large-scale trial involving other classes in the research school to test the effectiveness of the e-module.

The effectiveness test aimed to measure the impact of the ethnoscience-integrated e-module on temperature and heat, supported by Heyzine Flipbooks, in improving students' Literacy Science Abilities. The learning trial was conducted by administering a pretest before implementing the e-module and a posttest afterward. The N-gain formula provided an overview of the increase in students' learning outcomes from before to after the intervention. This increase was calculated by determining the difference between the pretest and posttest scores, normalized by the difference between the maximum score and the pretest score. The N-gain formula used in this research refers to Hake (1988). The results of the trial on improving students' Literacy Science Abilities are summarized in Table 2 and Figure 1.

Table 2. Average Literacy Science Abilities Score

No	Indicator	Average Score/Indicator			Category	Classical Mastery Criteria
		Pre-test	*Post-test*	*N-gain (%)*		
1	Explaining phenomena scientifically	26	72	63	Medium	Effective
2	Evaluating and designing scientific investigations	31	84	77	High	Effective
3	Interpreting data and evidence scientifically	30	76	65	Medium	Effective
Average		29	77	68	Medium	Effective

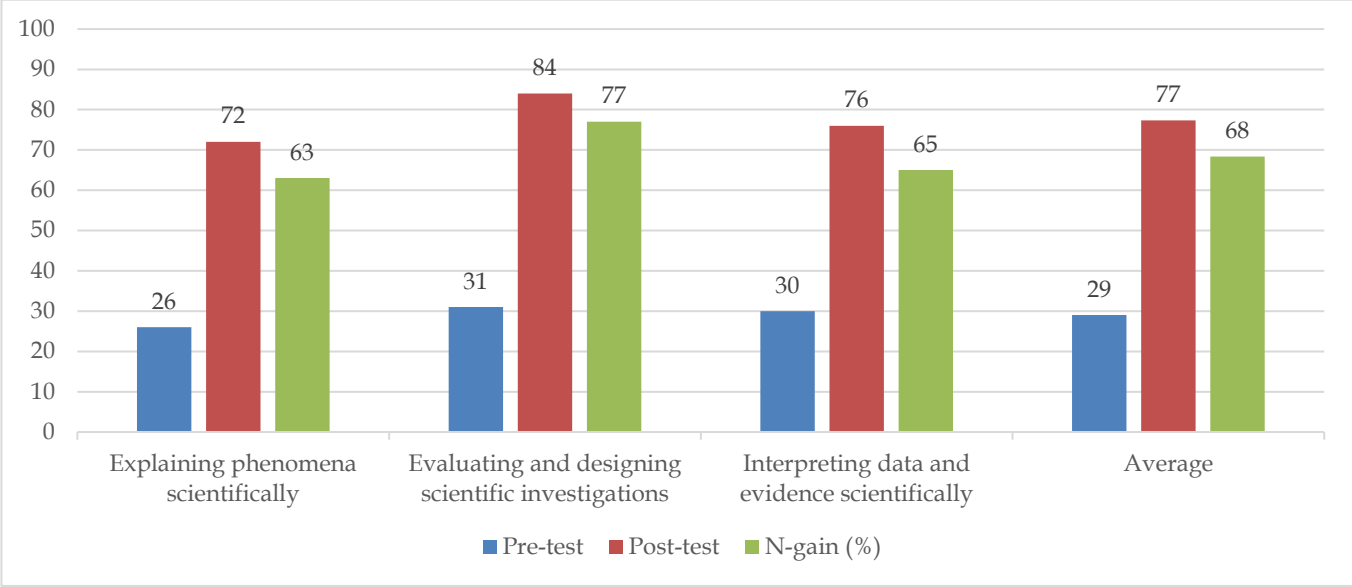

Figure 1. N-Gain Score for Each Indicator of scientific literacy abilities

Based on Table 2 and Figure 1, the scoring results indicate that the scientific literacy skills of 24 students, as analyzed from the data, show that the use of an e-module supported by Heyzine Flipbooks on the topic of temperature and heat, integrated with ethnoscience, contributes to improving students' scientific literacy skills. The average pre-test score of students was 29, which increased to 77 in the post-test, with an average N-Gain of 68%, categorized as moderate. This improvement indicates that the e-module is quite effective in helping students understand and apply scientific concepts in various contexts.

Each scientific literacy indicator showed an increase with varying degrees. The Evaluating and Designing Scientific Investigations indicator showed the highest improvement, with an N-Gain of 77%, indicating that students have become more capable of designing and assessing scientific procedures. The Interpreting Data and Scientific Evidence indicator also improved, with an N-Gain of 65%, demonstrating that students have become more skilled in understanding, analyzing, and presenting scientific data logically. Meanwhile, the Explaining Phenomena Scientifically indicator had the lowest N-Gain of 63%, suggesting that although there was an improvement, students still need reinforcement in connecting scientific concepts with the phenomena they observe.

This study aligns with research conducted by Sari et al. (2016), which found that ethnoscience-based learning on the concept of energy and its transformations using fish smoking practices could improve students' scientific literacy, with an N-Gain of 0.443 (moderate category). Other studies support these findings, such as the study by Zumaroh et al. (2024), which developed an ethnoscience-based e-module on the topic of states of matter and their changes, proving effective in enhancing elementary school students' scientific literacy. Additionally, Pratiwi et al. (2019) found that ethnoscience-based science learning significantly enhances 21st-century students' scientific literacy. The integration of Heyzine Flipbooks-supported e-modules with ethnoscience-based content is expected to foster a more meaningful learning experience, enhance student engagement, and strengthen their scientific literacy skills (Rahayu & Hidayat, 2021). Therefore, this study seeks to evaluate the effectiveness of Heyzine Flipbooks-assisted e-modules on the topic of temperature and heat, integrated with ethnoscience, in improving students' scientific literacy skills (Suryadi & Kaniawati, 2020).

Conclusion

The effectiveness of the e-module supported by Heyzine Flipbooks on the topic of temperature and heat integrated with ethnoscience is demonstrated through the improvement in the learning outcomes of 24 students. The average pretest score of the students was 29, which increased to 77 in the posttest, with an average N-Gain of 68%. These results indicate that the e-module is effective in enhancing students' scientific literacy abilities.

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Conflicts of Interest
None

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